

A new species of *Eutarsopolipus* Berlese (Acari: Podapolipidae) from *Agonum sexpunctatum* (L.) (Coleoptera: Carabidae) from Germany and notes on the *biunguis*-group of *Eutarsopolipus*

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(With 9 figures)

A b s t r a c t

Eutarsopolipus brevis n. sp. (Acari: Podapolipidae) is described from *Agonum sexpunctatum* (Coleoptera: Carabidae) from three localities in Germany and compared with related *Eutarsopolipus* in the *biunguis*-group of *Eutarsopolipus*. Figures of previously undescribed instars of *Eutarsopolipus* species in the *biunguis*-group, synonymy of *Eutarsopolipus* species, keys to species, new host and locality records and comments on the *biunguis*-group are presented.

I n t r o d u c t i o n

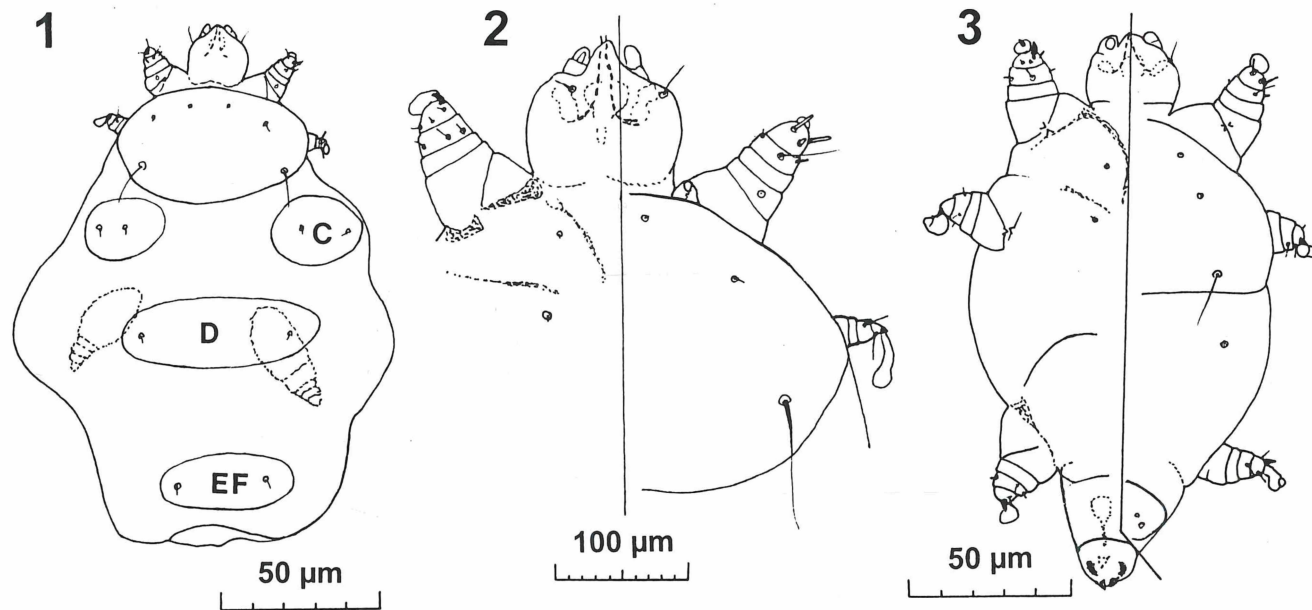
Mites in the family Podapolipidae (Acari: Tarsonemini) are all highly specialized ecto- and endoparasites of insects of the orders Blattaria, Orthoptera, Heteroptera, Hymenoptera and especially Coleoptera. All mites in the genus *Eutarsopolipus* Berlese, 1913 are ectoparasites of carabid beetles.

Hans Regenfuss, pioneer in the study of the Podapolipidae, died in 1979 leaving unfinished projects, including undescribed taxa of *Eutarsopolipus*. The Regenfuss Collection was acquired by Gisela Rack for the Zoological Museum, University of Hamburg, Germany in 1985. An examination of mites in the Regenfuss Collection yielded a new *Eutarsopolipus* species in the *biunguis*-group.

The purpose of this paper is to describe a new *Eutarsopolipus* species from the carabid beetle *Agonum sexpunctatum* (L.), collected in three localities in Germany. Moreover, the paper redescribes and illustrates instars of three species described by Regenfuss, eliminates *nomina nuda*, provides a key to eight species in the *biunguis*-group within *Eutarsopolipus* as modified from Regenfuss (1968) and presents new host, locality records and comment on that species complex.

M a t e r i a l s a n d M e t h o d s

Measurements were taken with the aid of a ZEISS phase contrast microscope with a drawing tube and stage micrometer. All measurements are in micrometers (µm). Setae no longer than



Figs 1-3. *Eutarsopolipus brevicus* n. sp.: 1 - adult female, dorsal aspect; 2 - adult female, propodosoma; 3 - male, ventral and dorsal aspects.

the diameter of their setal sockets are listed as microsetae (m). Often long setae are obscured, bent, broken or at an angle which makes measurement difficult. Setae are at least as long as indicated. Terminology is based on Lindquist (1986).

Type material is deposited in the Zoological Museum Hamburg (ZMH) and in the collection of the senior author, Adrian (RWH).

Systematics

Family Podapolipidae Ewing, 1922

Genus *Eutarsopolipus* Berlese, 1913

Eutarsopolipus brevic sp. n.

(Figs 1-4)

Eutarsopolipus oblongus: Regenfuss 1972 (p. 46, 50; *nomen nudum*).

DIAGNOSIS: Adult females of *E. brevic* sp. n. are distinguished from other members of the *biunguis*-group by lateral bulges at the level of plate *D*, divided plate *C*, undivided plates *D* and *EF*, by narrower plates *C* than those in its closest relative, i.e. *E. agonobius* Regenfuss, 1968 and shorter, spinelike setae *pl'* and *u''* on tarsi II, III (Table 1).

TYPE DATA. Holotype, adult ♀, 20 February 1969; collected by H. Regenfuss at Kirchhofen, Germany, from *Agonum sexpunctatum* (L.) (Coleoptera: Carabidae). ZMH, Acc. No A 30/1985-273.

Paratypes: allotype ♂, same data as holotype (ZMH, Acc. No A 30/1985-274); ♀, 1 larval ♀: same data as holotype; ♀, Kirchhofen, 27 June 1971; 4♀, 3♂, Gottenheim, 20 June 1971; 4♀, Gottenheim, 1 July 1971; 3♀, Veldensteiner Forst, 22 June 1971.

ETYMOLOGY. *E. brevic* sp. n. is named for a narrow plate *C* in the adult female.

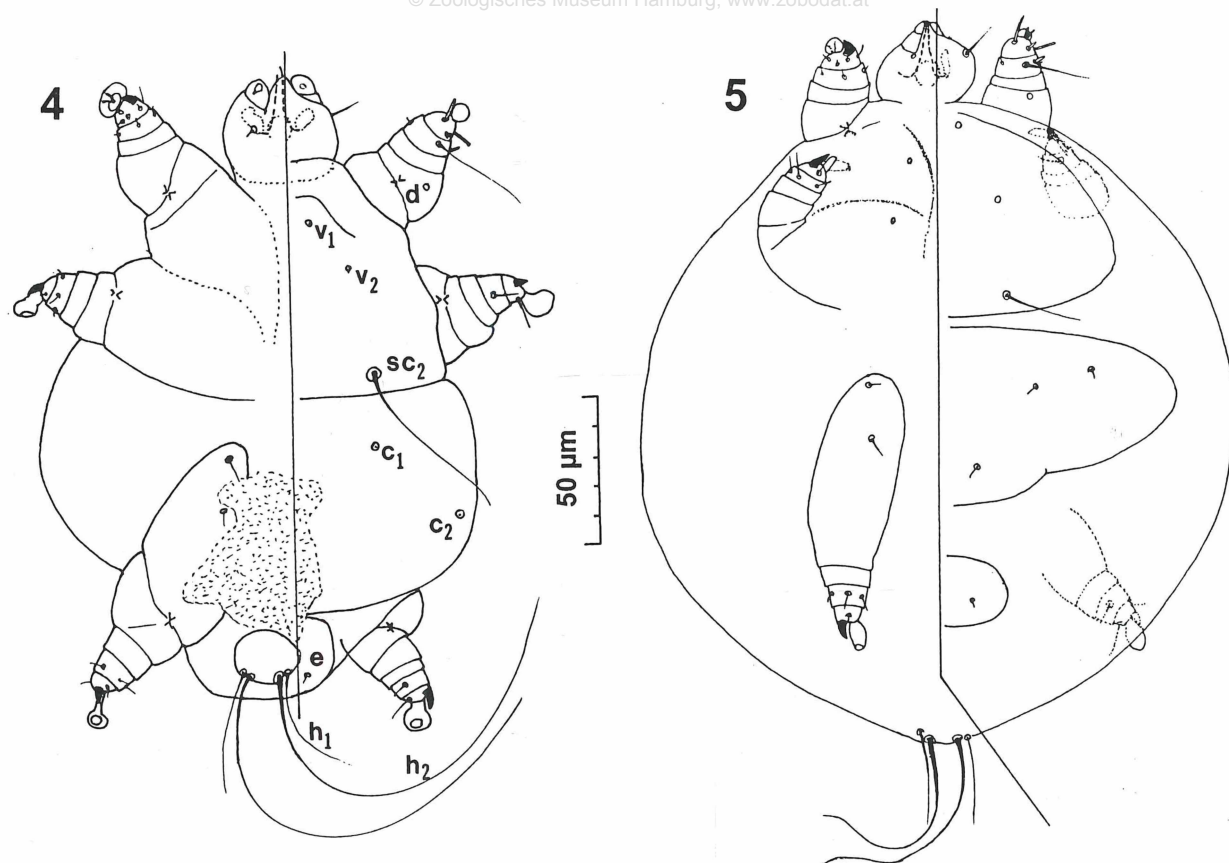
DESCRIPTION. ADULT FEMALE (Figs 1, 2). **Gnathosoma:** length 45-47, width 46-47. Cheliceral stylet length 35-40. Pharynx width 14-15, dorsal gnathosomal seta 11, ventral seta 3-5. Stigmata prominent, at posterolateral margin of gnathosoma.

Idiosoma: length 400-430, width 240-300. Prodorsal plate wider than long, setae *v*₁ (m), *v*₂ 3-4, *sc*₂ 35. Setae *v*₂ lateral to a line connecting *v*₁ and *sc*₂. Plate *C* divided, distance between plates *C* 62-107, plate *C* width 43-63, setae *c*₁ (m), *c*₂ (m)-6; plate *D* width 109-123, seta *d* 3-4. Plate *EF* width 78-85, seta *e* 5. Plate *H* width 40, setae *h*₁, *h*₂ (m).

Venter with apodemes 1 moderately developed, meeting sternal apodeme medially. Coxal setae 1a, 2a (m), 3a 5, 3b 7. Distance between setae 3a and 3b 13.

Legs: Leg setation as in Table 2. Ambulacrum I, II, III without claws. Femur I seta *d* (m). Tarsus I solenidion ω 3. Tibia I solenidion φ 4, seta *d* 24, tibia II seta *d* 5, tibia III seta *d* 5-6.

MALE (Fig. 3). **Gnathosoma:** length 27-28, width 26-29. Cheliceral stylet length 15-17, palp length 12; pharynx width 8, dorsal gnathosomal seta 5, ventral seta (m), distance between ventral setae 14.



Figs 4-5. *Eutarsopolipus brevicus* n. sp.: **4** - larval female, ventral and dorsal aspects; *Eutarsopolipus biunguis* Regenfuss: **5** - larval female, ventral and dorsal aspects.

I d i o s o m a: length 125-145, width 70-100. Prodorsal plate setae v_1 , v_2 (m), sc_2 19. Setae c_1 , c_2 , d (m). Venter with apodemes 1 and 2 moderately developed. Coxal setae 1a, 2a, 3a, 3b (m).

L e g s: leg setation as in Table 2. Ambulacrum I with one claw, length 5, ambulacra II, III without claws. Tarsus I solenidion ω (m). Tibia I solenidion ϕ 3. Tibia I seta d 10, tibia II seta d 3, tibia III setae d 5. Femur I setae d (m). Genital capsule length 45, width 35, with concave lateral margins.

LARVAL FEMALE (Fig. 4). **G n a t h o s o m a:** length 38, width 38. Cheliceral stylet length 26, pharynx width 10. Palp length 15; dorsal gnathosomal seta 12, ventral seta (m).

I d i o s o m a: length 188, width 153, setae v_1 , v_2 (m), sc_2 50. Distance between setae v_1 13; distance between setae sc_2 62. Setae c_1 , c_2 , d , e (m). Venter with apodemes 1 and 2 weakly developed. Coxal setae 1a, 2a (m); 3a 8, 3b 4-5. Distance between setae 3a and 3b 20. Setae h_1 166, h_2 60. Distance between setae h_1 8.

L e g s: Setation pattern as in the male. Ambulacrum I with small claws, 5; ambulacra II, III without claws. Femur I seta d (m). Tarsus I solenidion ω 3. Tibia I solenidion ϕ 4, seta k 3. Tibia I seta d 35, tibia II, III setae d 6.

Larval female and male of *E. biunguis*, *E. globosus* and *E. agonobius* were not illustrated by Regenfuss (1968) and males and larval females of *E. globosus* and *E. agonobius* were not described. Redescriptions of larval and adult females of the species above and descriptions of males and larval females of *E. globosus* and *E. agonobius* are presented for comparison with new and existing species.

Eutarsopolipus biunguis Regenfuss, 1968
(Fig. 5)

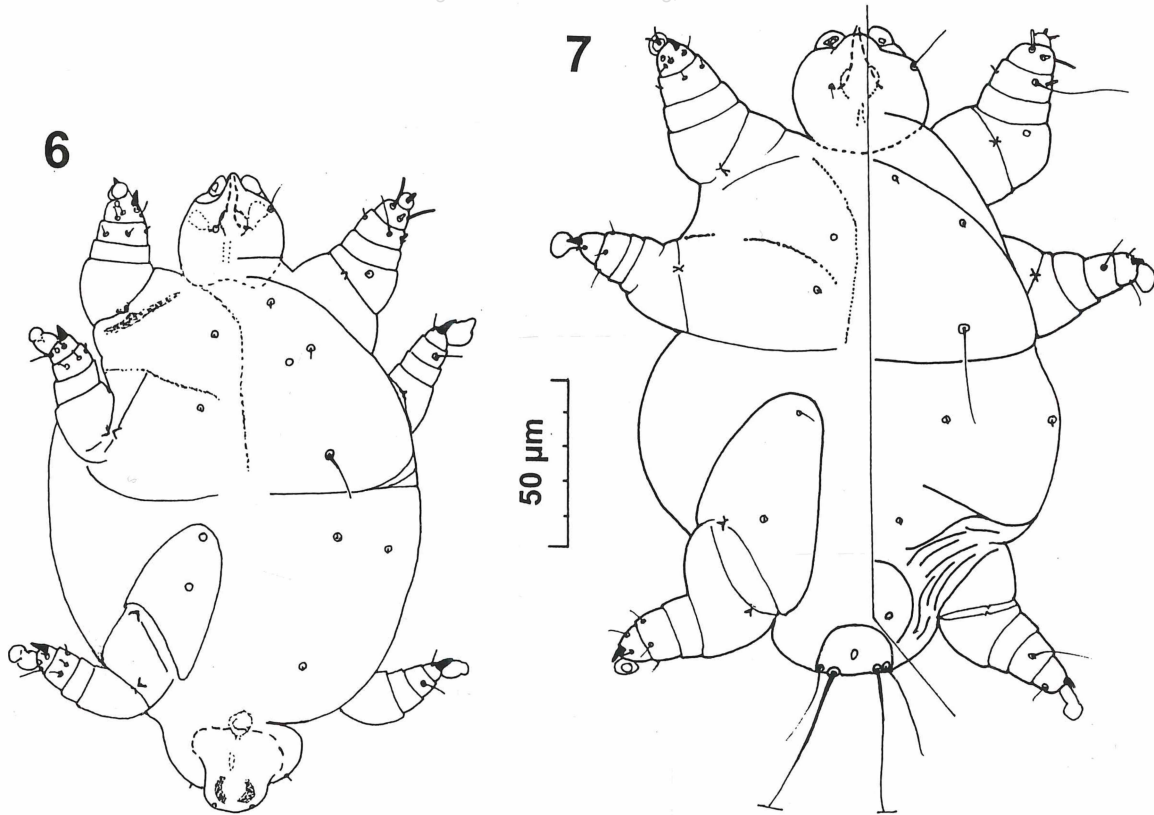
REDESCRIPTION. ADULT FEMALE. **G n a t h o s o m a:** length 48-49, width 42-50. Cheliceral stylet length 32-39. Pharynx width 15-16, dorsal gnathosomal seta 20, ventral seta 5. Stigmata prominent, at posterolateral margin of gnathosoma.

I d i o s o m a: length 330-378, width 310-360. Prodorsal plate wider than long, setae v_1 3-9, v_2 7-20, sc_1 vestigial, sc_2 40-45. Setae v_2 lateral to a line connecting v_1 and sc_2 . Plate C not divided, width 220-225, setae c_1 6-10, c_2 7-10; plate D width 150-152, seta d 7. Plate EF width 110-140, seta e 7. Coxal setae 1a (m), 2a (m), 3a 4-6, 3b 4-7. Distance between setae 3a and 3b 23.

L e g s: leg setation as in Table 2. Ambulacrum I without claws, ambulacra II, III claws 3-4. Femur I seta f' 4-5, seta d (m). Tarsus I solenidion ω 3. Tibia I solenidion ϕ 3-5, seta d 20, tibia II seta d 6, tibia III seta d 6-8.

LARVAL FEMALE (Fig. 5). **G n a t h o s o m a:** length 30-34, width 36-37. Cheliceral stylet length 24-28, pharynx width 8. Palp length 12; dorsal gnathosomal seta 15, ventral seta (m).

I d i o s o m a: length 170-230, width 150-183, setae v_1 , v_2 (m), sc_2 45. Distance between setae v_1 32; distance between setae sc_2 49. Setae c_1 5, c_2 (m), d 3, e (m).



Figs 6-7. *Eutarsopolipus globosus* Regenfuss: 6 - male, ventral and dorsal aspects; 7 - larval female, ventral and dorsal aspects.

Venter with apodemes 1 and 2 weakly developed. Coxal setae 1a, 2a (m); 3a 6, 3b 9. Distance between setae 3a and 3b 24. Setae h_1 77, h_2 30. Distance between setae h_1 7.

L e g s: setation pattern as in adult female. Ambulacrum I with small claws 5; ambulacra II, III claws minute, 2-3. Femur I seta d (m). Tarsus I solenidion ω (m). Tibia I solenidion ϕ 4, seta k (m). Tibia I seta d 20, tibia II setae d 6, tibia III setae d 7.

New distribution records of *E. biunguis*, all collected by H. Regenfuss, are: Dechsendorf, Germany, 29 August 1963, 30 August 1963, 31 March 1964 and one female and larva with no date or locality, all from *Agonum viduum* (Panzer, 1797).

Eutarsopolipus globosus Regenfuss, 1968
(Figs 6, 7)

Eutarsopolipus irregularis: Regenfuss 1972 (p. 46, 60; *nomen nudum*).

REDESCRIPTION: ADULT FEMALE. **G n a t h o s o m a:** length 46, width 52. Cheliceral stylet length 31. Pharynx width 10, dorsal gnathosomal seta 17, ventral seta 7. Stigmata prominent, at posterolateral margin of gnathosoma.

I d i o s o m a: length 280, width 279. Prodorsal plate wider than long, setae v_1 5, v_2 9, sc_2 25. Setae v_2 lateral to a line connecting v_1 and sc_2 . Plate C divided, plate C width 58-65, setae c_1 thick 4, c_2 thick 3; plate D width 47-52, seta d 5. Plate EF width 71, seta e 7. Plate H length 20, width 34, setae h_1 , h_2 m. Coxal setae 1a (m)-3, 2a (m)-5, 3a (m)-10, 3b (m)-7. Distance between setae 3a and 3b 23.

L e g s: leg setation as in Table 2. Ambulacra I, II, III without claws. Femur I seta I' , d (m). Tarsus I solenidion ω 5. Tibia I solenidion ϕ 5, seta d 12, tibia II seta d 9, tibia III seta d 6.

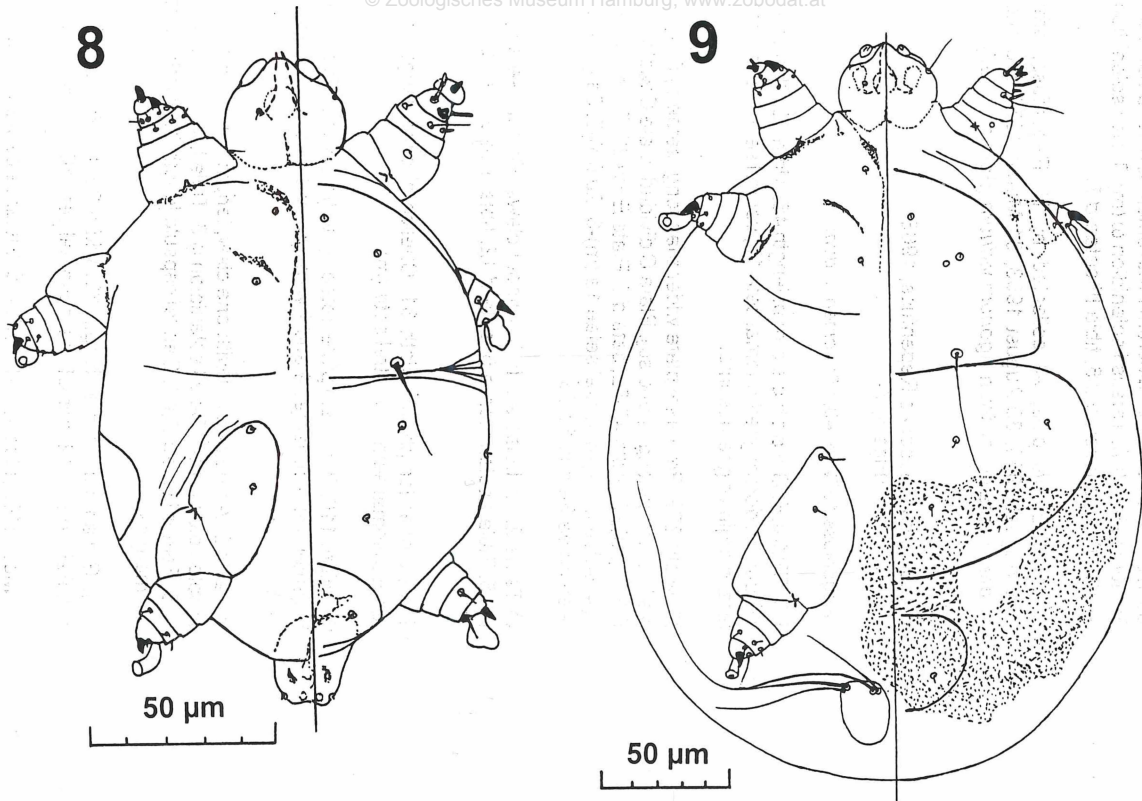
MALE (Fig. 6). **G n a t h o s o m a:** length 32, width 31. Cheliceral stylet length 19, pharynx width 8, dorsal gnathosomal seta 8, ventral seta (m).

I d i o s o m a: length 162, width 110. Prodorsal plate setae v_1 , v_2 (m), sc_1 vestigial, sc_2 13. Setae c_1 , c_2 , d , e (m). Venter with apodemes 1 and 2 weakly developed. Coxal setae 1a, 2a, 3a, 3b (m).

L e g s: leg setation as in Table 2. Ambulacrum I with one claw, length 4, ambulacra II, III without claws. Tarsus I solenidion ω (m). Tibia I solenidion ϕ 3. Tibia I seta d 11, tibia II seta d 7, tibia III setae d 6. Femur I setae d (m). Genital capsule length 26, width 25 at base, with concave lateral margins.

LARVAL FEMALE (Fig. 7). **G n a t h o s o m a:** length 32, width 35. Cheliceral stylet length 25, pharynx width 9. Palp length 12; dorsal gnathosomal seta 16, ventral seta 5.

I d i o s o m a: length 210, width 216, setae v_1 , v_2 (m), sc_2 48. Distance between setae v_1 21; distance between setae sc_2 62. Setae c_1 , c_2 , d , e (m). Venter with apodemes 1 and 2 weakly developed. Coxal setae 1a, 2a (m); 3a 8, 3b (m). Distance between setae 3a and 3b 29. Setae h_1 160, h_2 30. Distance between setae h_1 8.



Figs 8-9. *Eutarsopolipus agonobius* Regenfuss: 8 - male, ventral and dorsal aspects; 9 - larval female, ventral and dorsal aspects.

Legs: setation pattern as in the male. Ambulacrum I with small claws, 5; ambulacra II, III without claws. Femur I seta *d* (m). Tarsus I solenidion ω 3. Tibia I solenidion ϕ 5, seta *k* (m). Tibia I seta *d* 30, tibia II seta *d* 18, III setae *d* 34.

New host and distribution records of *E. globosus*, all collected by H. Regenfuss, are: Rheinweiler, 9 June 1969 and Wyhl, 2 July 1971, from *Agonum marginatum* (L.); Rheinweiler, 9 June 1969 from *Agonum muelleri* (Herbst, 1785); Kleinkems, 19 May 1968, Rheinweiler, 26 April 1969 and 10 June 1969 from *Paranchus albipes* (Fabricius, 1796) (all in Germany).

Eutarsopolipus agonobius Regenfuss, 1968
(Figs 8, 9)

REDESCRIPTION. ADULT FEMALE. **Gnathosoma:** length 45–49, width 46. Cheliceral stylet length 32–40. Pharynx width 15, dorsal gnathosomal seta 13, ventral seta 5. Stigmata prominent, at posterolateral margin of gnathosoma.

Idiosoma: length 300–360, width 190–240. Prodorsal plate wider than long, setae v_1 (m), v_2 5, sc_2 34. Setae v_2 lateral to a line connecting v_1 and sc_2 . Plate *C* divided, width 110, setae c_1 3, c_2 9; plate *D* width 144, seta *d* 4. Plate *EF* width 92, seta *e* 5. Coxal setae 1a 4, 2a 4, 3a 10, 3b 7. Distance between setae 3a and 3b 40.

Legs: leg setation as in Table 2. Ambulacra I, II, III without claws. Femur I seta *d* (m). Tarsus I solenidion ω 4. Tibia I solenidion ϕ 4, seta *d* 20, tibia II seta *d* 15, tibia III seta *d* 8.

Male (Fig. 8). **Gnathosoma:** length 30, width 33. Cheliceral stylet length 17–20, pharynx width 10, dorsal gnathosomal seta 3, ventral seta (m).

Idiosoma: length 162, width 123. Prodorsal plate setae v_1 , v_2 (m), sc_2 20–30. Setae c_1 , c_2 , *d* (m). Venter with apodemes 1 and 2 moderately developed. Coxal setae 1a, 2a, 3a, 3b (m).

Legs: leg setation as in Table 2. Ambulacrum I with one claw, length 5, ambulacra II, III without claws. Tarsus I solenidion ω 3. Tibia I solenidion ϕ 3. Tibia I seta *d* 9, tibia II, III setae *d* 5. Femur I setae *d* m. Genital capsule length 24–25, width 22, with concave lateral margins.

LARVAL FEMALE (Fig. 9). **Gnathosoma:** length 35, width 38. Cheliceral stylet length 25, pharynx width 10. Palp length 10; dorsal gnathosomal seta 13, ventral seta 3.

Idiosoma: length 232, width 202, setae v_1 , v_2 (m), sc_2 48. Distance between setae v_1 21. Setae c_1 (m), c_2 , *d*, *e* 3. Venter with apodemes 1 and 2 weakly developed. Coxal setae 1a 3, 2a (m); 3a 9, 3b 5. Distance between setae 3a and 3b 22. Setae h_1 150, h_2 45. Distance between setae h_1 7.

Legs: setation pattern as in the male. Ambulacrum I with small claws, 5; ambulacra II, III without claws. Femur I seta *d* (m). Tarsus I solenidion ω 3. Tibia I solenidion ϕ 4, seta *k* (m). Tibia I seta *d* 32, tibiae II, III setae *d* 5.

New distribution records for *E. agonobius* are: Gottenheim, 20 June 1971, 1 July 1971 and Veldensteiner Forst, 22 June 1971, from *A. sexpunctatum*.

Table 1. Maximum measurements of *Eutarsopolipus* in the *biunguis*-group: *E. biunguis* (= *bingu.*), *E. globosus* (*globo.*), *E. agonobius* (*agono.*), *E. trichognathi* (*trich.*), *E. lindquisti* (*lindq.*), *E. elzingai* (*elzin.*), *E. platyni* (*platy.*) and *E. brevicisp. n. (brevi.)*. (D = divided plate C or D).

Character	bingu.	globo.	agono.	trich.	lindq.	elzin.	platy.	brevi.
FEMALE								
idiosomal length	378	498	360	550	410	630	475	430
idiosomal width	360	428	240	352	295	570	449	300
cheliceral stylets	39	35	40	54	39	44	48	40
pharynx width	16	17	15	19	17	21	17	15
plate C width	225	65D	110D	208	270	255	145D	70D
plate D width	152	54D	144	135	246	223	205	118
setae:								
dorsal gnathosomal	20	17	13	23	12	12	12	15
ventral gnathosomal	5	7	5	15	4	4	3	7
v_1 / v_2	9/20	5/7	2/5	5/5	3/8	4/7	5/6	2/4
c_2	10	3	9	5	10	9	8	6
h_1	m	m	0	0	0	0	0	0
femur I I'	5	m	m	4	0	0	3	0
coxa 3a / 3b	6/7	10/7	10/7	8/8	4/4	9/5	9/5	5/7
MALE								
idiosomal length	140*	168	162	173	138	162	196	145
idiosomal width	120*	129	123	113	97	122	131	100
cheliceral stylets	16*	22	20	23	13	14	21	17
gen. capsule length	25*	26	25	27	33	10	43	45
gen. capsule width	30*	25	22	30	35	16	35	43
dorsal gnath. setae	-	8	3	8	m	6	7	5
LARVAL FEMALE								
idiosomal length	230	210	232	332	230	188	188	188
idiosomal width	183	216	202	160	220	144	137	152
cheliceral stylets	28	25	25	32	-	29	32	26
pharynx width	8	11	10	13	-	11	10	10
dorsal gnath. setae	15	16	13	16	-	20	15	12
setae sc_2	45	48	48	123	18	43	58	50
setae h_2	30	30	45	12	17	47	35	60
setae h_1-h_1	7	12	7	3	5	9	17	8
setae v_1-v_1	32	21	14	22	7	16	28	15

* From Regenfuss 1968.

Discussion

Regenfuss (1968) described the *biunguis*-group of *Eutarsopolipus* to include the following species: *E. biunguis*, *E. globosus* and *E. agonobius*. Species added to this group since 1968 are: *E. trichognathi* Husband and Eidelberg, 1996, *E. lindquisti* Husband, 1998a, *E. elzingai* Husband, 1998b, *E. platyni* Husband and Husband, 2002 and the one species described herein.

Neither the female holotype or a paratype of *E. biunguis* have ambulacrum I claws but both have small (3-4) ambulacra II, III and claws in contrast to no claws in the other seven species. Characters for the *biunguis*-group as conceived by Regenfuss (1968) are: in adult females, setae v' , v'' developed, epimere III present, setae c_2 present, ambulacral II, III without claws (true for all but *E. biunguis*), ambulacrum I without a claw, genu III without a seta, trachea and stigma present, tibia/tarsus I separate, cheliceral stylets in forward part of gnathosoma, three idiosomal tergites, femur I seta l' small or not present, larval female trochanter I without a flap, setae h_1 not widely separated and with plate *EF* narrower than plate *D*, male with genital capsule about as long as the width of the base, conical and with sides concave.

Eutarsopolipus species which are parasites of beetles in the carabid genus *Agonum* are all members of the *biunguis*-group of *Eutarsopolipus* except *Eutarsopolipus* sp. from *Agonum chathamii* Van Dyke, 1953, collected in the Galapagos Islands. Adult females of this species have well developed ambulacral I, II, III claws in contrast to no ambulacral I claws in the *biunguis*-group. *E. lukoschusi* Husband, 1986 could be considered in the *biunguis*-group as adult females have no or very small ambulacral I claws and no ambulacral II, III claws. Both *Eutarsopolipus* sp. from the Galapagos Islands and *E. lukoschusi* have femur I seta v'' well developed in contrast to this seta not present in the *biunguis*-group. We conclude that these two species do not belong in this species complex.

Table 2. Leg setation for femora (F), genua (G), tibiae (Ti), tarsi (Ta) for adult females of *Eutarsopolipus biunguis*, *E. globosus*, *E. agonobius*, *E. trichognathi*, *E. lindquisti*, *E. elzingai*, *E. platyni* and *E. brevic* sp. n. (Femur I seta l' and tibia I seta k are difficult to see. They are included if they are not microsetae. Tarsus I seta u'' is only clear in *E. platyni*).

Species in <i>biunguis</i> -group	Leg I				Leg II				Leg III			
	F	G	Ti	Ta	F	G	Ti	Ta	F	G	Ti	Ta
<i>E. biunguis</i>	2	0	6	8	0	0	4	5	0	0	4	5
<i>E. globosus</i>	1	0	7	8	0	0	4	5	0	0	4	5
<i>E. agonobius</i>	1	0	6	8	0	0	4	5	0	0	4	5
<i>E. trichognathi</i>	2	0	7	8	0	0	4	5	0	0	4	5
<i>E. lindquisti</i>	1	0	7	8	0	0	4	5	0	0	4	5
<i>E. elzingai</i>	1	0	6	8	0	0	4	5	0	0	4	5
<i>E. platyni</i>	2	0	6	9	0	0	4	6	0	0	4	5
<i>E. brevic</i> sp. n.	1	0	6	8	0	0	4	5	0	0	4	5

Regenfuss (1972) discusses the concept of microhabitats as related to adult female podapolipid mites on carabids. Idiosomal shapes and cheliceral stylet lengths of adult female mites are related to spaces occupied on host species. Different species of parasitic mites occupy different spaces on carabid hosts. Thus, it is logical that different host beetles should have different species of podapolipid mite parasites. In most cases, this appears to be true. Regenfuss (1968) also noted that adult females of the *myzus*-group of *Eutarsopolipus* may be distinguished by shape but larvae and males are very similar and are difficult to separate. We found the same difficulty with species in the *biunguis*-group.

Key to adult females of *biunguis*-group in *Eutarsopolipus*

1. Plate C entire 2
- Plate C divided 5
2. Without small ambulacral II, III claws 3
With small ambulacral II, III claws *E. biunguis*
3. Femur I seta *l'* vestigial or not present 4
- Femur I seta *l'* conspicuous (3-4) *E. trichognathi*
4. Idiosomal setae *c*₁, *d*, *e* longer (12, 10, 8) *E. lindquisti*
- Idiosomal setae *c*₁, *d*, *e* shorter (6, 5, 3) *E. elzingai*
5. Plate D entire 6
- Plate D divided *E. globosus*
6. Cheliceral stylets shorter than 45 (32-40) 7
- Cheliceral stylets 45 or longer (48) *E. platyni*
7. Tarsi III setae *pl'*, *u'* long (12), plate C wider (110) *E. agonobius*
- Tarsi III setae *pl'*, *u'* short (7), plate C narrower (50-70) *E. brevic* sp. n.

Zusammenfassung

Eine neue Milbenart aus der Familie Podapolipidae (Acari, Prostigmata, Tarsonemini), *Eutarsopolipus brevic* sp. n., wird aus Süddeutschland beschrieben und mit verwandten Arten der *biunguis*-Gruppe verglichen. Die Art ist ein Ektoparasit des Laufkäfers *Agonum sex-punctatum* (L.) (Coleoptera, Carabidae). Drei andere Arten von dieser Gruppe, *E. biunguis*, *E. globosus* und *E. agonobius*, werden nachbeschrieben. Ein Bestimmungsschlüssel für alle acht Arten der *biunguis*-Gruppe wird präsentiert.

References

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